Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	135.940	112.643	152.559	0.000	152.559	56.819	44.779	35.236	30.711	Continuing	Continuing
630320: *Air Force Vanguards*	-	135.940	112.643	152.559	0.000	152.559	56.819	44.779	35.236	30.711	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Program develops and delivers transformational operational capabilities through advanced technology solutions which focus on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

Department of the Air Force Vanguard programs are focused, priority initiatives with enterprise commitment which incorporate multidisciplinary solutions to advance and accelerate emerging Science and Technology driven capabilities and warfighting concepts. High risk by design, Vanguards seek to answer specific questions to inform future acquisition programs and identify gaps where additional research is still needed.

The DAF Technology Executive Officer partners with Air Force Futures (A5/7), USSF (CTIO, USSF/S5B), and the Deputy Assistant Secretary (Science, Technology and Engineering) to identify and to recommend emerging technologies as Vanguard Prospect investments through a deliberate, multidisciplinary and multifunctional process. The Future Transformational Capabilities major thrust enables the Department of the Air Force to respond rapidly to these emerging Science and Technology investment opportunities within the budget cycle and launch future Vanguard Program candidates closely aligned to validated DAF future force needs. The subsequent process to commission new Vanguard Programs is co-chaired by the Under Secretary of the Air Force, Vice Chief of Staff of the Air Force, and Vice Chief of Space Operations.

The current Air Force Vanguard programs are Skyborg, Golden Horde, Navigation Technology Satellite 3 (NTS-3), and Rocket Cargo. Skyborg will integrate artificial intelligence into autonomous unmanned air vehicles to enable future manned-unmanned teaming. Golden Horde will transition the demonstrated networked collaborative autonomous weapon core capability into a digital ecosystem for additional advancement. NTS-3 will demonstrate technologies and tactics involving space, control, and user equipment for advanced satellite navigation, in order to provide robust and resilient, agile augmentation to the GPS system. Rocket Cargo will demonstrate new trajectories and ways to fly large rockets, the ability to land rockets at austere locations, and design & test an ejectable pod for air drop.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

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B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	147.350	131.643	0.000	0.000	0.000
Current President's Budget	135.940	112.643	152.559	0.000	152.559
Total Adjustments	-11.410	-19.000	152.559	0.000	152.559
• Congressional General Reductions	0.000	-19.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	-6.305	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-5.105	0.000			
• Other Adjustments	0.000	0.000	152.559	0.000	152.559

Change Summary Explanation

FY 2021 reduction ($6.305 million) Congressional Directed Transfer for Section 219.
FY 2021 reduction ($5.105 million) SBIR/STTR Transfer.
FY 2022 reduction ($19.000 million) Congressional Directed Reduction for Rocket Cargo-program growth.
The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Future Transformational Capabilities	9.200	9.063	32.432
Description: Identify game-changing transformational Science and Technology investment opportunities through the WARfighter-TECHnologist (WARTECH) process. The WARTECH process brings together technologists and DAF requirement officials to assess the best intersection of technology readiness and DAF future force design priorities. Select programs will be designated Vanguards indicating enterprise-level priority and a transition partner endorses the program. Future Transformational Capability funds will be used to kick-start newly designated Vanguard programs to accelerate capability development and transition and respond to emerging technology opportunities within the budget cycle.			
FY 2022 Plans: Kick-start one or more of the six WARTECH topics and initiate Transformational Component Vanguard program(s) identified through the FY21-22 WARTECH process and approved by DAF. Perform modeling, simulation, and analyses used to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.			
FY 2023 Plans:			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Continue investments that address DAF priorities such as achieving operationally optimized command and control, achieving target engagement at scale, and defining optimized resilient basing, sustainment, and communications. Investments will leverage Artificial Intelligence and gaming technologies to accelerate DAF capability to create theatre-scale operational plans within hours; demonstrate a capability for high speed delivery of area effects; enable multi-domain sense-making at the tactical edge; and create an effective, layered defense of air bases. Complete the WARTECH 3.0 process to investigate several DAF prioritized topics and initiate timely launch of several Transformational Component Vanguard Prospect programs. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 Funding increased compared to FY 2022 by $23.369 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Title: Navigation Technology Satellite 3 (NTS-3)	47.294	16.110	10.735
Description: Develop and demonstrate advanced space-based navigation system technologies to provide resilient navigation support in contested environments. The demonstration includes a space-based test vehicle, ground based enterprise command and control, and agile software defined receivers for the user. ***FY 2022 Plans:*** Complete development of advanced space-based navigation technology demonstration. Complete Ground Control System software and hardware, and integrate in New Mexico and Colorado ground control sites. Complete final software defined receiver hardware and release final user equipment software, and conduct end-to-end system functional test and space signal validation. Complete final system integration, test, and launch. Complete spacecraft final integration, environmental testing, and functional tests, and ship to launch site for anticipated launch. Complete system End-to-End Integration and Test. Initiate entire system checkout, once on-orbit, to prepare for experimentation with potential for follow-on residual operations led by a non-Air Force Research Laboratory organization. ***FY 2023 Plans:*** Complete experimental operations training and rehearsals. Complete all experiment plans and finalize experimental procedures and 1-year on-orbit experiment schedule. Complete final user equipment software release and deploy all receivers to CONUS sites to support experimental data collection. Deliver certifications of flight readiness and ship fully integrated and tested spacecraft to launch site, and support launch activities. Once on-orbit, initiate contact the spacecraft and perform initial system checkout period, maneuver to intended experimental orbit, and conduct first six months of experimentation. Prepare for transition to follow-on residual operations led by a non-Air Force Research Laboratory organization in mid-FY24. ***FY 2022 to FY 2023 Increase/Decrease Statement:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by $5.375 million. Funding decreased due to completing test & spacecraft integration and ground control system deployment to mission operations control site, and transitioning to final integrated system tests, experimental operations rehearsals, and launch integration.			
Title: Skyborg	45.127	58.570	46.680
Description: Skyborg is an autonomous, attritable vehicle architecture suite which will enable the Air Force to posture, produce and sustain multi-mission sorties at sufficient tempo to thwart adversary attempts at quick, decisive action in contested and highly contested environments. Skyborg is organized into three main lines of effort (LOEs). LOE 1 develops, demonstrates, and prototypes the Autonomy Core System (ACS) consisting of Skyborg autonomy architecture and software, enabling machine-machine and manned-unmanned teaming, while also ensuring openness, modularity, and expandability of the Skyborg autonomy mission systems suite. The ACS LOE also develops, demonstrates, and prototypes the hardware components and Open Architecture standards needed to allow modular sensor, communication, and other payload integration into the Skyborg autonomy and vehicle architectures in systems integration laboratories and platforms. LOE 2 (Low-cost vehicles) develops, demonstrates, and prototypes new low cost attritable vehicle concepts and technologies for expeditionary mass generation including sortie generation employment concepts. LOE 3 (Operational Experimentation) conducts analysis and experimentation on concepts of operations and concepts of employment for attritable, autonomous, unmanned systems and assesses the openness, and modular capabilities / sensors integration for autonomous, attritable, aircraft and mission systems. ***FY 2022 Plans:*** Continue development and demonstration of Skyborg Autonomy Core System hardware and software open architecture and components. Continue maturation and transition of human-machine interfaces, human systems interfaces and live, virtual & constructive technologies for command and control of autonomous systems. Continue demonstration and transition of government open architectures for autonomous unmanned systems. Continue demonstration and transition of a DevSecOps pipeline for the Skyborg Autonomy Core system software architecture. Complete development and demonstration of technologies for situational awareness, advanced autonomous behaviors, and survivability for unmanned systems. Complete demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments. Continue integration, demonstration and transition of a digital engineering enterprise autonomous low-cost weapon system model and system integration laboratory. ***FY 2023 Plans:*** Complete development, demonstration, and transition of Skyborg Autonomy Core System hardware and software open architecture and components. Complete maturation and transition of human systems interfaces for autonomous systems. Complete demonstration and transition of government open architectures for autonomous unmanned systems. Complete demonstration and transition of a DevSecOps pipeline for the Skyborg Autonomy Core system software architecture. Complete creation and start-up of a digital integration facility including a system integration laboratory, digital engineering modeling,			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
simulation and analysis laboratory and hardware/software-in-the-loop test facility for transition of Skyborg technology to program customers. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 funding decreased compared to FY 2022 by $11.89 million. Funding decreased due to planned program requirements and completing the demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments.			
Title: Golden Horde ***Description:*** Integrate networked collaborative technologies into selected inventory weapon systems. Technologies can include new payloads, weapon datalinks/radios, and autonomous behaviors that are bounded by operator-defined mission rules of engagement. Supports the integration of Air Force weapons into the Joint All-Domain Command/Control network. Develop new standard software and hardware architecture environment to accelerate change for new weapon systems. This environment will integrate new concept designs via simulations, virtual and live testing, and operational analysis, experiments and war games to show the value of collaborative weapons in increasing combat power across the spectrum of conflict. Work with Weapons Program Executive Officer to define requirements for future weapons and Concept of Operations. ***FY 2022 Plans:*** Vanguard effort will complete efforts in FY 2022 through final demonstrations of networked collaborative technologies via simulations, testing, operational analysis, experiments and war-games. Complete work with operational users to define Concepts of Operation (CONOPs) in future force structures and future employment scenarios. ***FY 2023 Plans:*** Continue development of the multi-tier digital weapon ecosystem, consisting of a high fidelity, government owned, open architected, live, virtual, and constructive development pipeline for Networked Collaborative and Autonomous (NCA) technology and tactics. Complete the Software Integration and Simulation Laboratory. Complete the hardware-in-the-loop environment. Continue conducting yearly challenges where both traditional and non-traditional suppliers can compete new NCA weapon technology using Government reference architectures to accelerate delivery and verification of new weapon technology. Continue building the repository of industry NCA weapon technology and containerized NCA algorithms/software to have off-the-shelf solutions for new weapon development programs. Initiate demonstration of UAS surrogate capability to conduct high fidelity live-constructive testing of NCA technology with a mix of live and simulated vehicles. Prepare to transition the ecosystem to potential users/partners. ***FY 2022 to FY 2023 Increase/Decrease Statement:***	34.319	0.000	18.812

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 funding increased compared to FY 2022 by 18.812 million. Funding increased due to a planned re-phase of activities caused by a directed revector of the program and initiation of demonstration of UAS surrogate capability to conduct high fidelity live-constructive testing of NCA technology with a mix of live and simulated vehicles.			
Title: Rocket Cargo	0.000	28.900	43.900
Description: The Department of the Air Force (DAF) seeks to leverage the current multi-billion dollar commercial investment to develop the largest rockets ever, and with full reusability to develop and test the capability to leverage a commercial rocket to deliver DAF cargo anywhere on the Earth in less than one hour, with a 100-ton capacity. The DAF is not investing in the commercial rocket development, but rather investing in the Science & Technology needed to interface the capability with DoD logistics needs, and extend the commercial capability to DoD-unique missions. Provides a new, faster and cheaper solution to the existing TRANSCOM Strategic Airlift mission. Enables AFSOC to perform current Rapid-Response Missions at lower cost, and meet a one-hour response requirement. Rocket Cargo uses modeling, simulation, and analysis to conduct operational analysis, verify military utility, performance, and operational cost. S&T will include novel "loadmaster" designs to quickly load/unload a rocket, rapid launch capabilities from unusual sites, characterization of potential landing surfaces and approaches to rapidly improve those surfaces, adversary detectability, new novel trajectories, and an S&T investigation of the potential ability to air drop a payload after reentry. This is not a rocket engine or launch vehicle development program. It is an S&T effort to leverage the commercial development into a novel new DoD capability. ***FY 2022 Plans:*** Mature effort in leveraging commercial space launch to create military capability in Rocket-based Cargo delivery. Complete S&T testing leveraging the current commercial prototype testing. Perform site measurements needed to integrate the capability onto DoD missions including plume-surface physics and toxicity, loads, detectability, and acoustics. Also, complete initial AFRL wind tunnel testing to assess novel trajectories needed for air-drop capability, and high-speed separation physics. Under contract and CRADA, partner with Commercial to test and demonstrate an initial one-way transport capability to an austere site. Seek to perform an early end-to-end test to fully identify the technical challenges. In addition, complete Industry outreach for loadmaster concepts including novel container designs, load/unload concepts, and testing the compatibility of AF cargo with rocket launch and space environments. Issue solicitation and award contracts. ***FY 2023 Plans:*** Leveraging the commercial development, initiate the first-ever deorbit and land with a large payload thereby testing the full stress on the thermal protection system, in-flight trajectory control, and landing leg strength. Initiate validation of Computational-fluid-dynamic (CFD) models using wind tunnels and commercially-leverage flight test that will enable the first in-depth S&T of high-speed separation options where the ejected payload is released in the anti-velocity direction. Complete assessment of the rocket vulnerability and detectability using leveraged field-test campaigns. Complete plume toxicity, acoustic and pad-material degradation experiments across a wider range of test parameters afforded by the commercial development, and update the AF			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
CFD models accordingly. Initiate field research, in partnership with NASA, to investigate the plume interactions with a variety of materials expected for landing on Earth. Initiate efforts to design/test off-load apparatus optimized for the AF logistics mission set. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 funding decreased compared to FY 2022 by $4.0 million. Funding decreased due to completion of S&T testing leveraging the current commercial prototype testing and testing to assess novel trajectories needed for air-drop capability, and high-speed separation physics			
Accomplishments/Planned Programs Subtotals	135.940	112.643	152.559

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not applicable